

Fig. 1

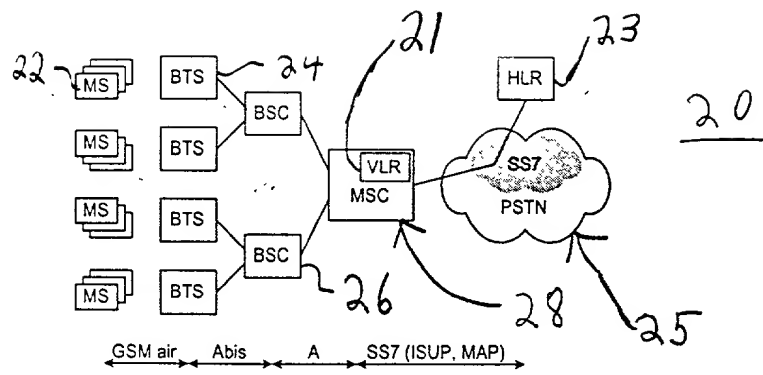


Fig.2

The diagram illustrates a UTRAN network architecture. A Mobile station is connected to a serving MSC (32) via a radio interface. The serving MSC is part of a UTRAN system (3.4) which also includes a VLR. The VLR and serving MSC are connected to a central SS7 Network. The SS7 Network is connected to an HLR (30) and a gateway MSC (38) via UMTS MAP interfaces. The serving MSC is also connected to the SS7 Network via an ISUP interface. The entire UTRAN system is labeled 32.

Fig. 3

400

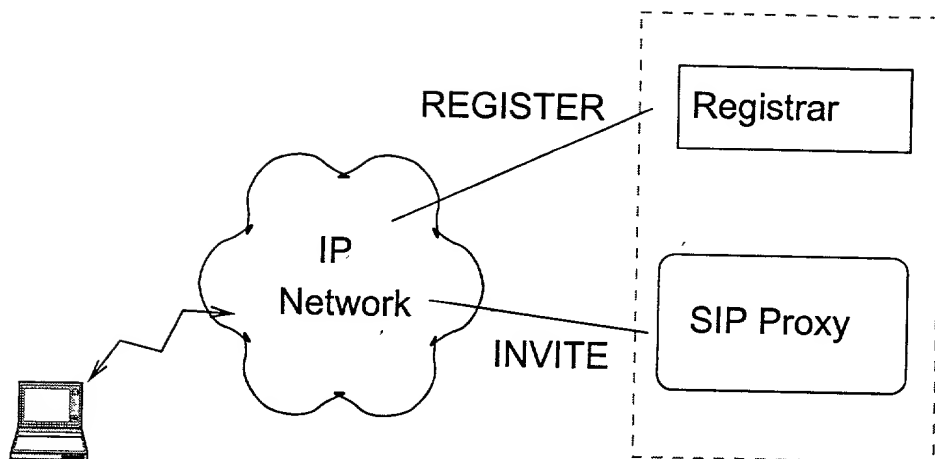


Fig. 4

Analogous entities in SIP and UMTS	
UMTS	SIP
HLR	Registrar
Gateway MSC	Home proxy server
Serving MSC	End system (for REGISTER)
MSISDN	User address (in INVITE)
IMSI	User address (in REGISTER)
MSRN	Device address

Fig. 5

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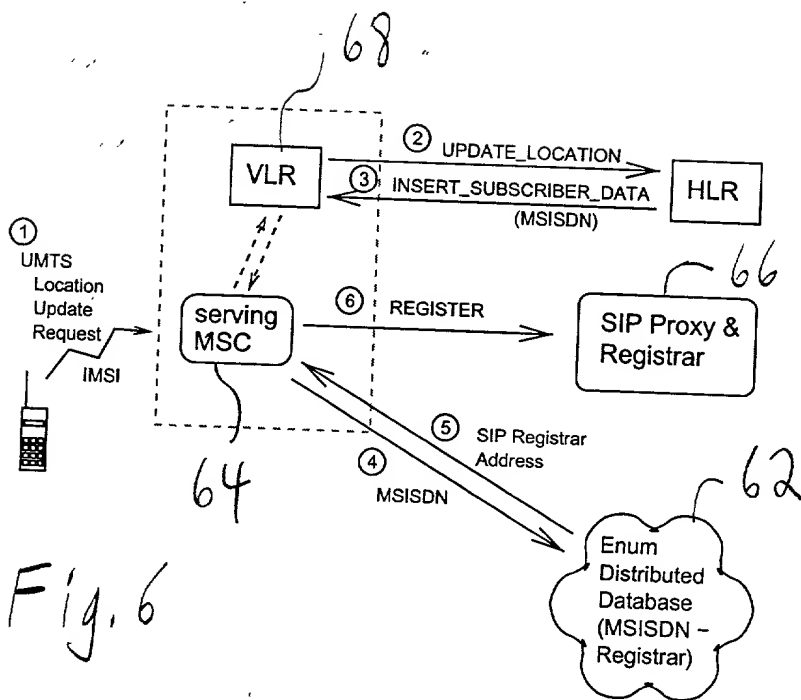
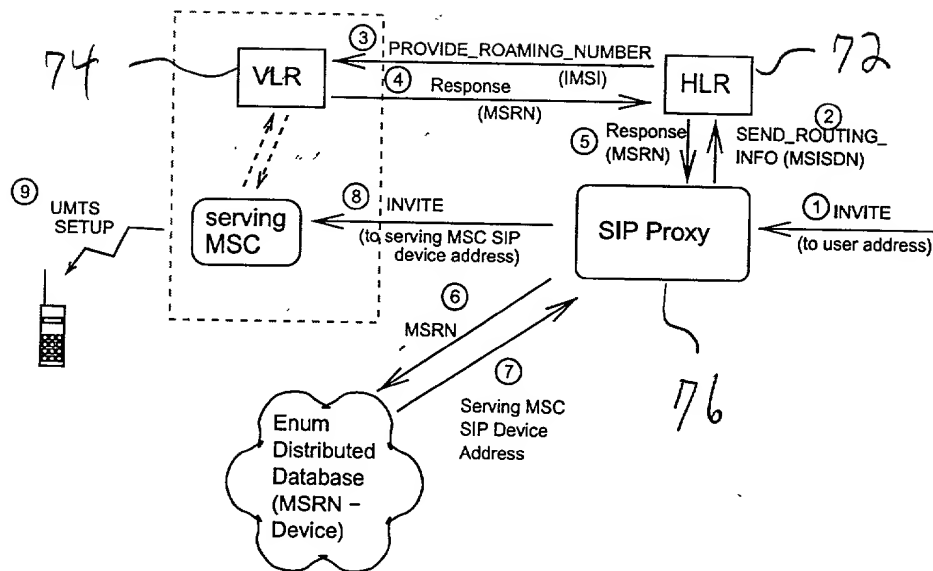


Fig. 6

093543-03201

Fig. 7



093513-00204

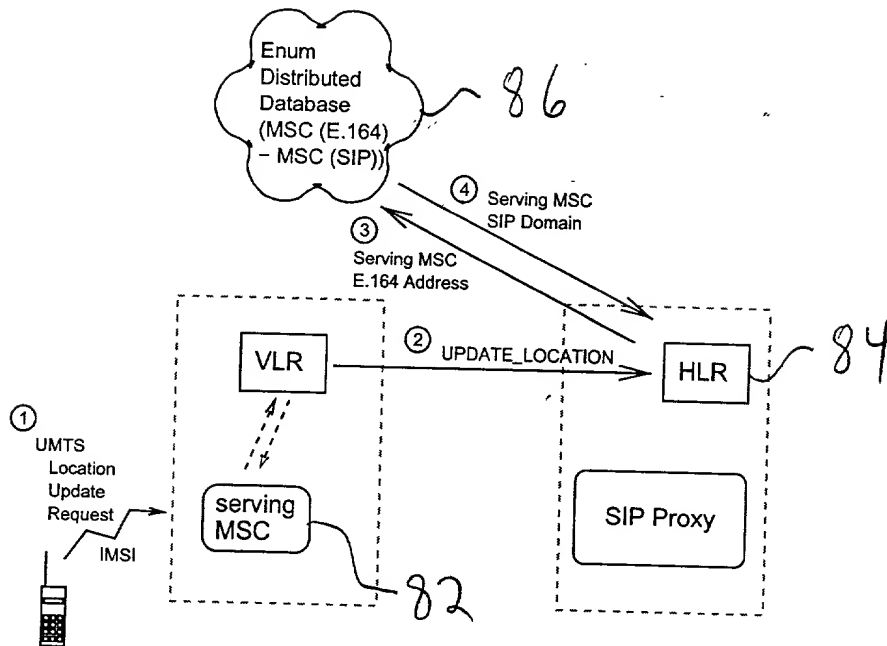


Fig. 8

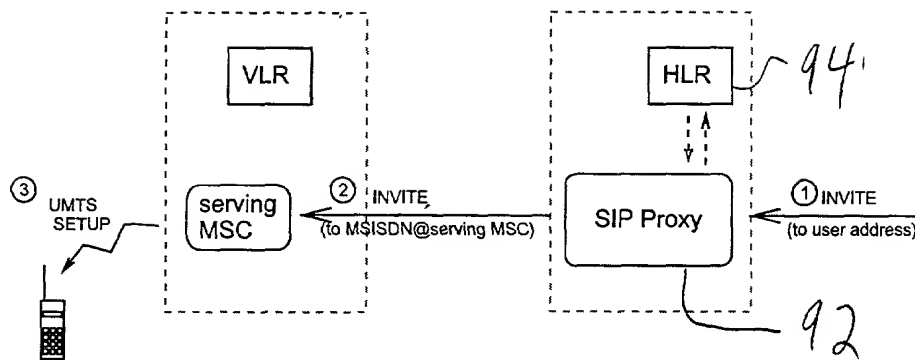


Fig. 9



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Message weights		
Symbol	Parameter	Value
$w_{sip}$	Weight of a SIP message	1.0
$w_{isup}$	Weight of an ISUP message	1.0
$w_{dns}$	Weight of a DNS message	0.5
$w_{map}$	Weight of a MAP message	1.5

Fig. 10

Mobility parameters		
Symbol	Parameter	Value
$r_{in}, r_{out}$	Rate of call delivery / origination	variable
$r_{bc}$	Average boundary crossing rate	variable
$P_t(t)$	Boundary crossing rate prob. distribution ( $P(t_0 \geq t)$ )	$e^{-r_{bc}t}$
$s$	Call / mobility ratio	$\frac{r_{out} + r_{in}}{r_{bc}}$
$P_{nr}$	Prob. that a device is new to a serving MSC	50%
$P_{ur}$	Prob. that a device has a unique registrar at its serving MSC	20%
$P_{us}$	Prob. that a device has a unique serving MSC at its HLR/registrar	20%

Fig.11

Protocol parameters

Symbol	Parameter	Value
$t_{\text{sip}}$	SIP registration refresh interval	3 hr
$t_{\text{dns}}$	DNS cache time-to-live	24 hr
$c_{\text{auth}}$	Number of pieces of authentication data cached at VLR	5

Fig. 12

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Fig.13

Case	Formula
<u>Modified Registration</u>	
Registration	$r_{bc}((8 + 2/c_{auth}) w_{map} + (2P_{nr} + 4P_{ur}) w_{dns} + 4(1 + \sum_{i=1}^{\infty} P_t(it_{sip})) w_{sip})$
Call setup	$r_{in}(4P_{us}w_{dns} + 1w_{sip})$
<u>Modified Call Setup</u>	
Registration	$r_{bc}(8 + 2/c_{auth}) w_{map}$
Call setup	$r_{in}(4w_{map} + 6P_{us}w_{dns} + 1w_{sip})$
<u>Modified HLR</u>	
Registration	$r_{bc}((8 + 2/c_{auth}) w_{map} + 2P_{us}w_{dns})$
Call setup	$r_{in}(4P_{us}w_{dns} + 1w_{sip})$

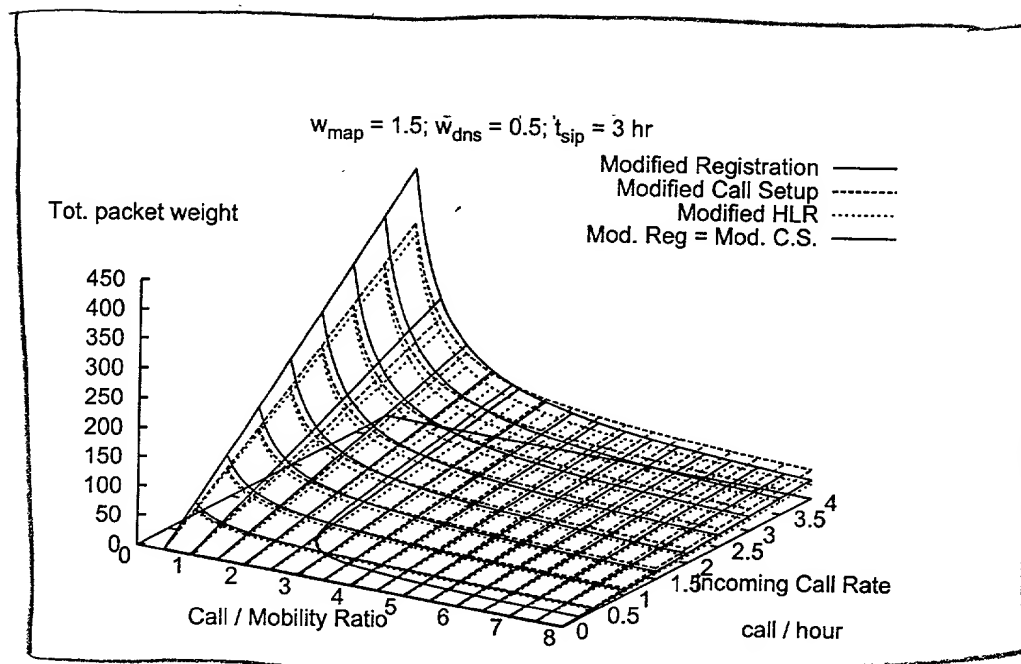


Fig. 14

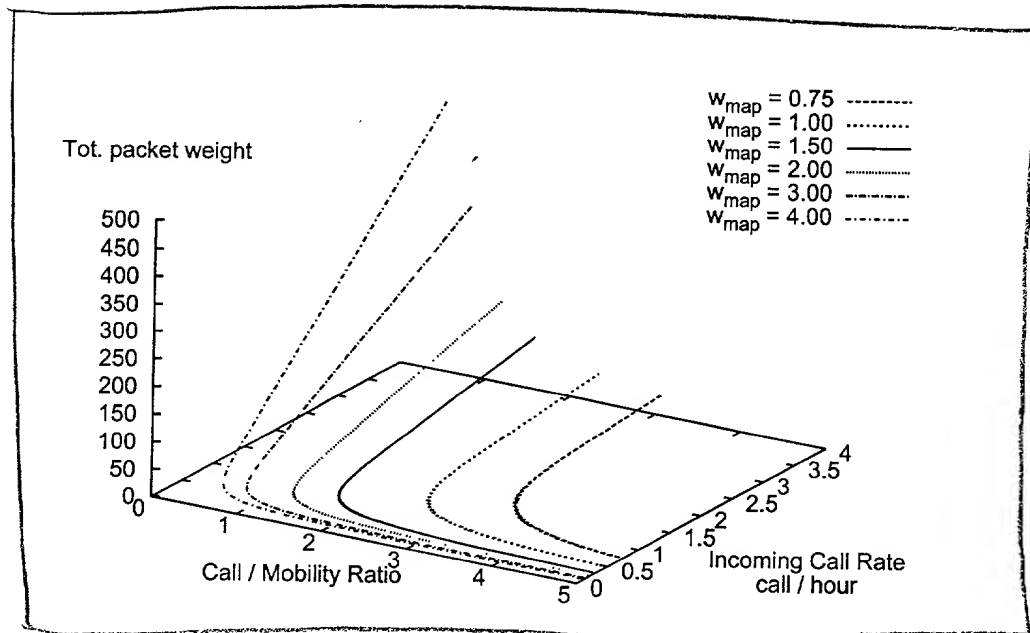
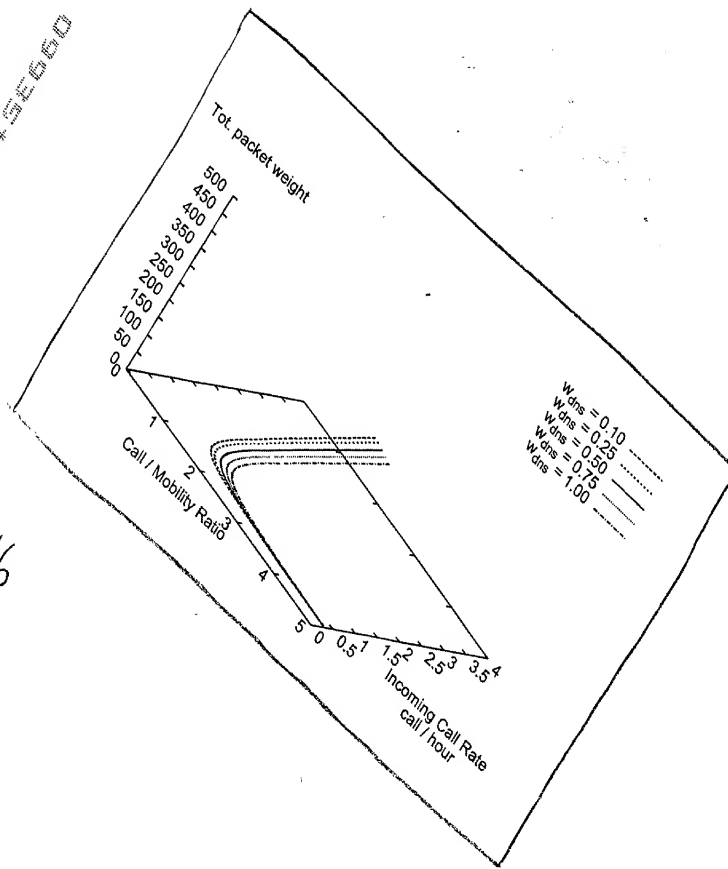
[illegible]

Fig. 15

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Fig. 16



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T02220"8T5E660

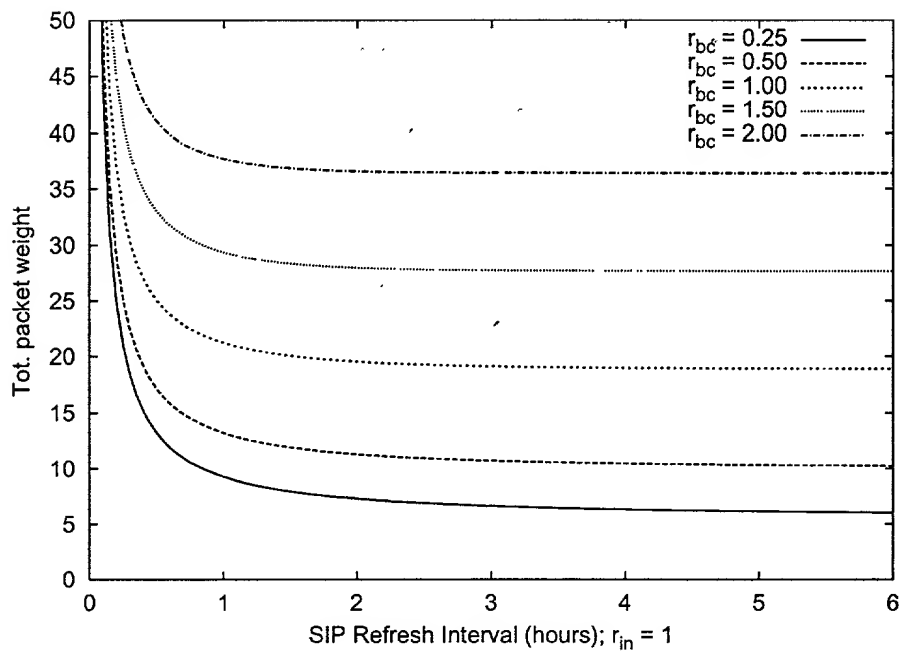


Fig.17



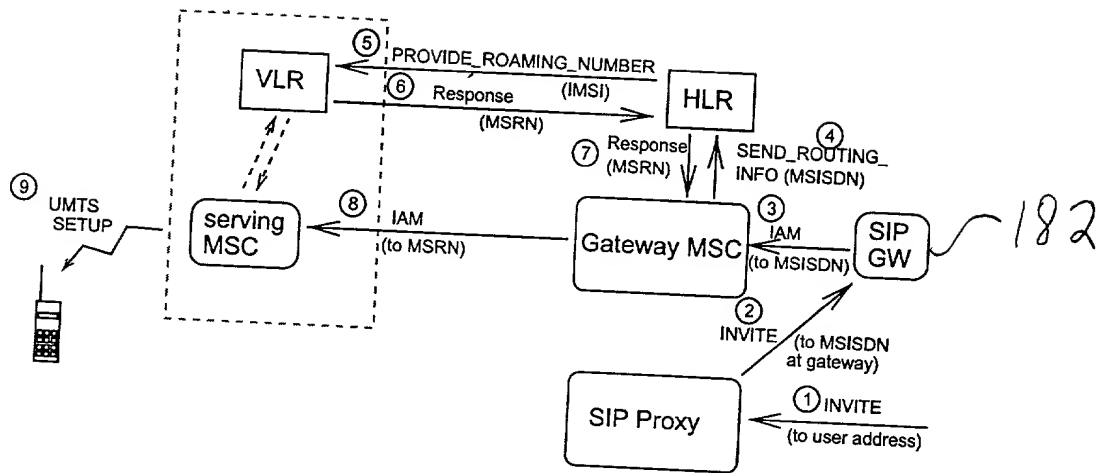
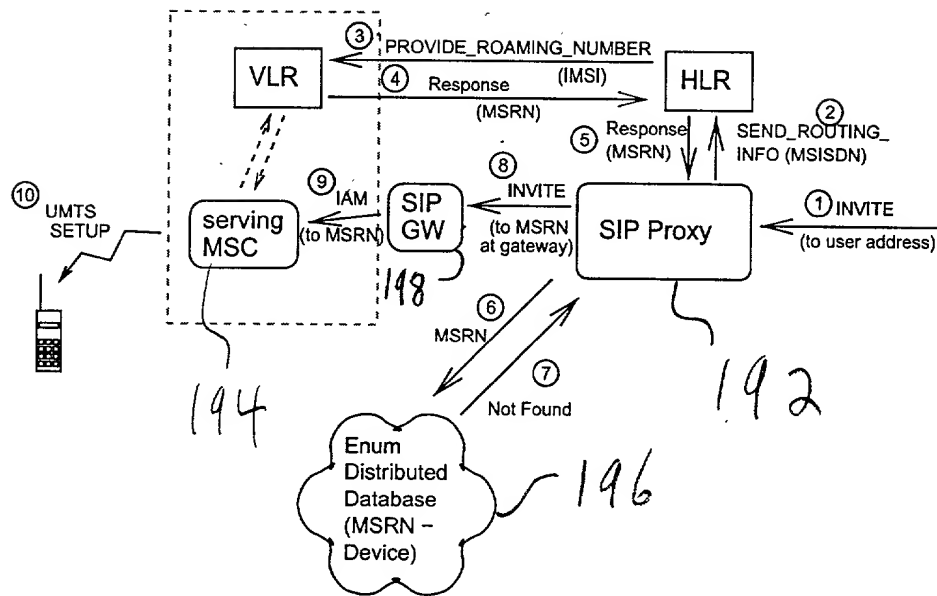


Fig. 18

Fig. 19



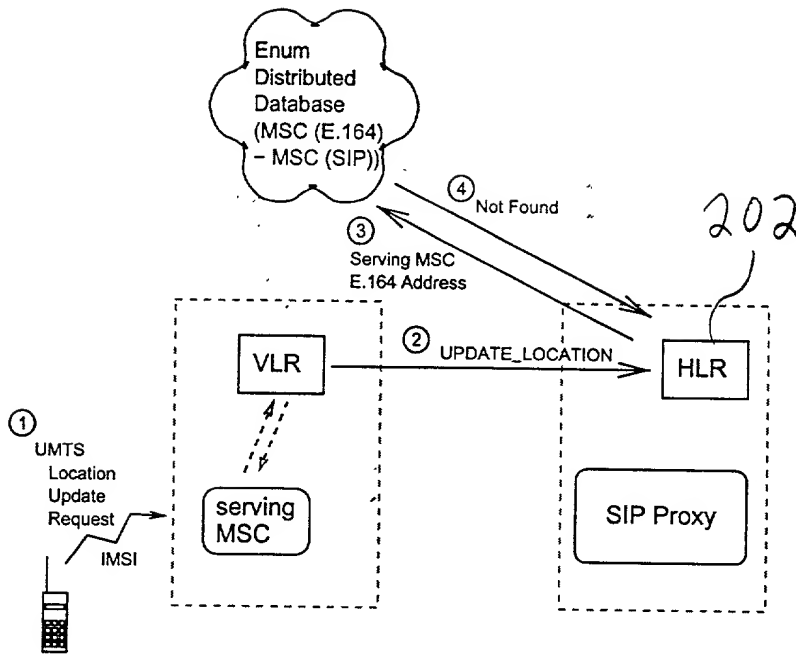


Fig. 20

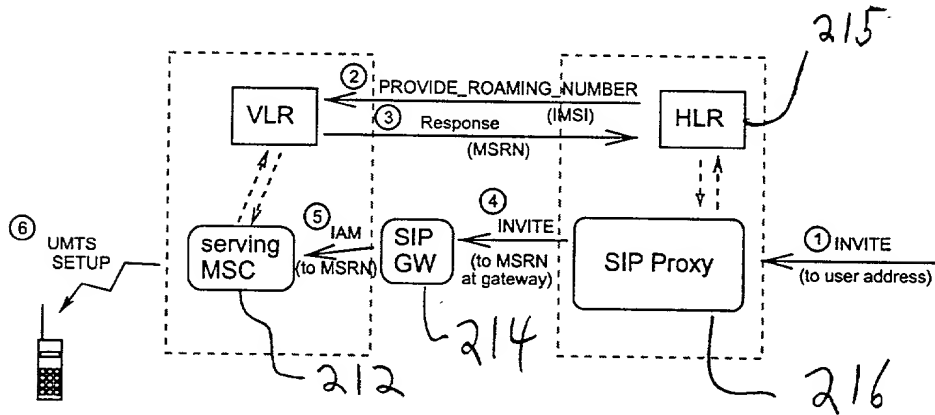


Fig. 21

Case	Formula
Modified Registration	
Registration	$r_{bc} (8 + 2/c_{auth}) w_{map}$
Call setup	$r_{in} (4w_{map} + 1w_{sip} + 2w_{isup})$
Modified Call Setup	
Registration	$r_{bc} (8 + 2/c_{auth}) w_{map}$
Call setup	$r_{in} (4w_{map} + 6P_{us}w_{dns} + 1w_{sip} + 1w_{isup})$
Modified HLR	
Registration	$r_{bc} ((8 + 2/c_{auth}) w_{map} + 2P_{us}w_{dns})$
Call setup	$r_{in} (2w_{map} + 4P_{us}w_{dns} + 1w_{sip} + 1w_{isup})$

Fig. 22

0993518-03201

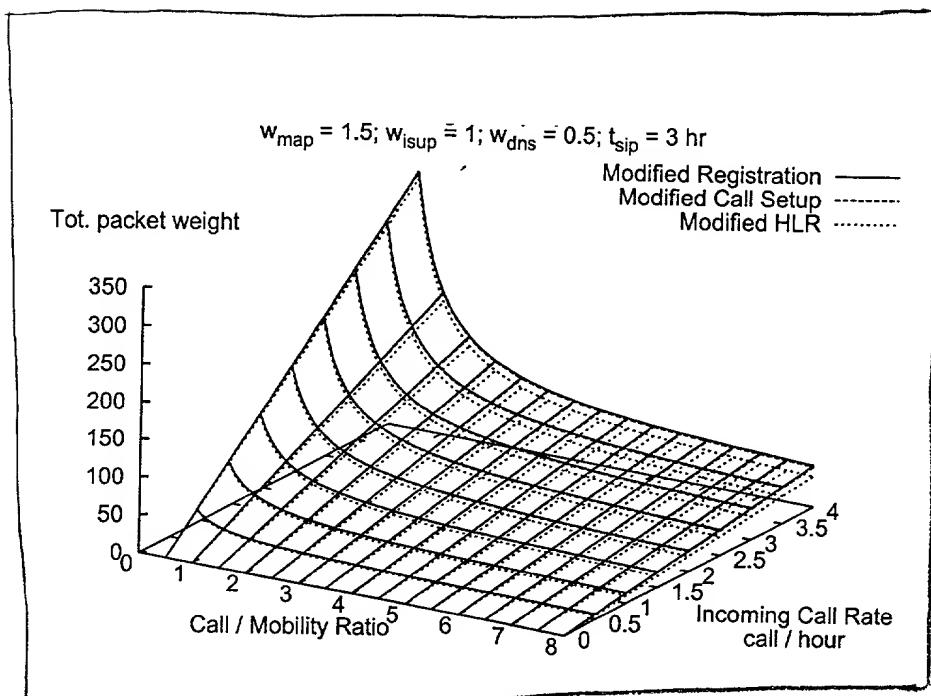


Fig.23

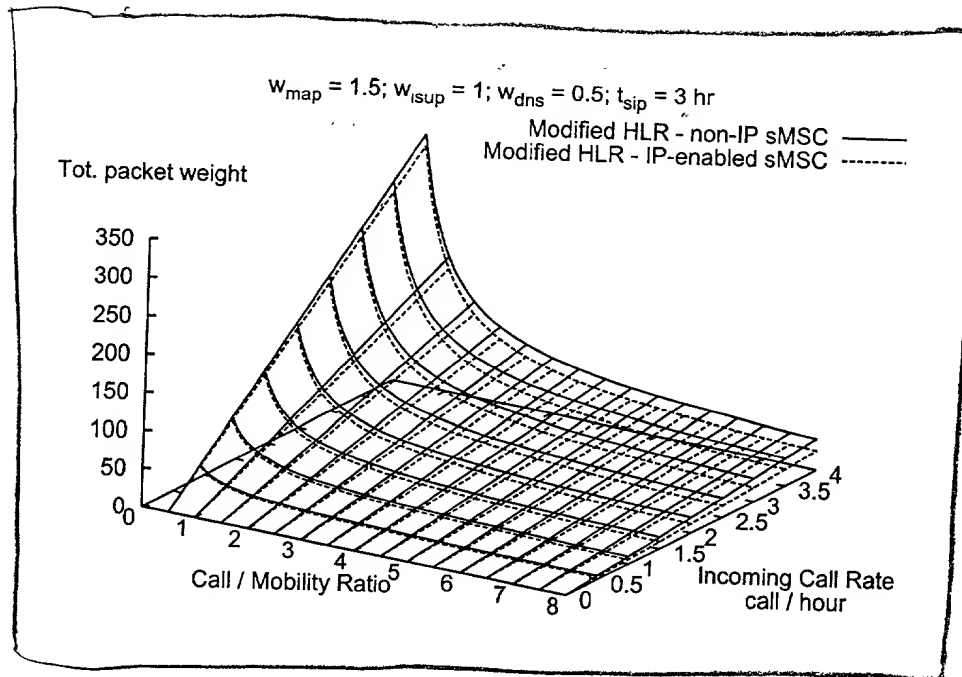


Fig. 24

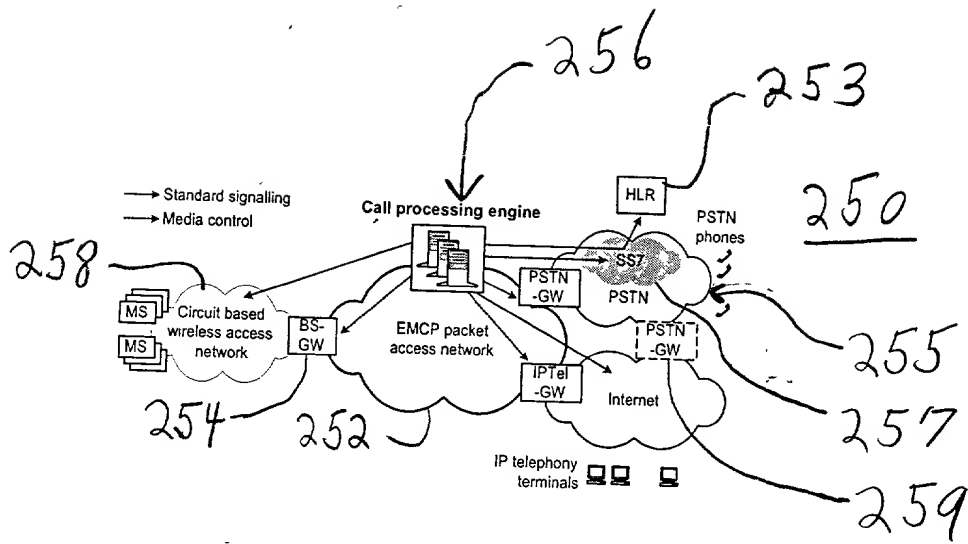


Fig. 25

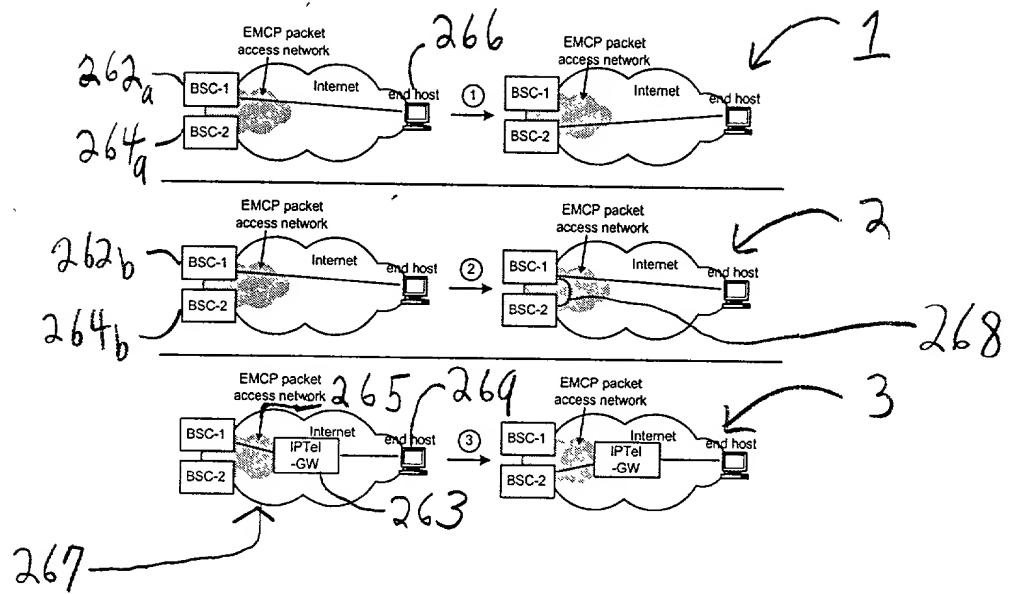


Fig.26



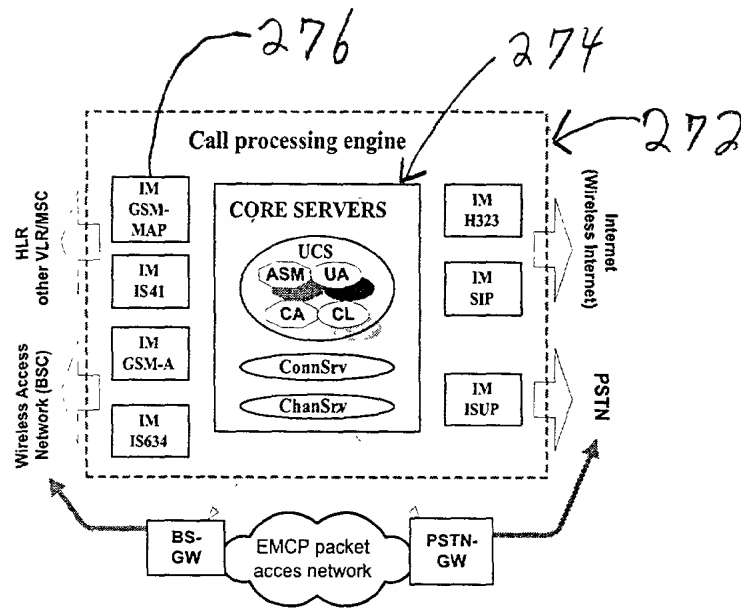


Fig.27

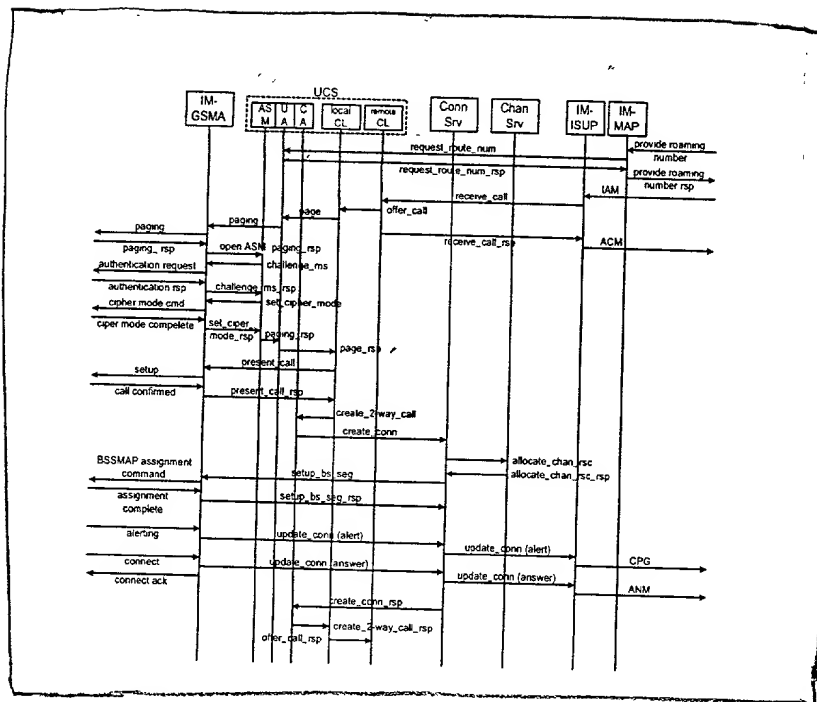


Fig. 28

4

Fig. 29

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## INDEPENDENT PARAMETERS.

	Description	Value
$P$	Number of processors (system size)	4
$N$	Average number of registered users	[80K,400K]
$l_c$	Call arrival rate (Poisson)	(0.3,5.5)
$r_c$	Ratio of MO calls within $l_c$	2/3
$u$	Call holding time (Exponential)	90 secs
$l_r$	Mobile registration rate (near-Poisson)	[0.1,2.0]
$r_r$	Inter-MSD registration ratio within $l_r$	1/7

Fig. 30

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3/2

DERIVED PARAMETERS.

	Description	Value
$l_c \cdot r_c$	MO call arrival rate (Poisson)	(0.2, 3.65)
$l_c \cdot (1 - r_c)$	MT call arrival rate (Poisson)	(0.1, 1.82)
$l_r \cdot r_r$	Boundary crossing rate	[0.014, 0.29]
$t$	Call setup latency	measured

Fig.31

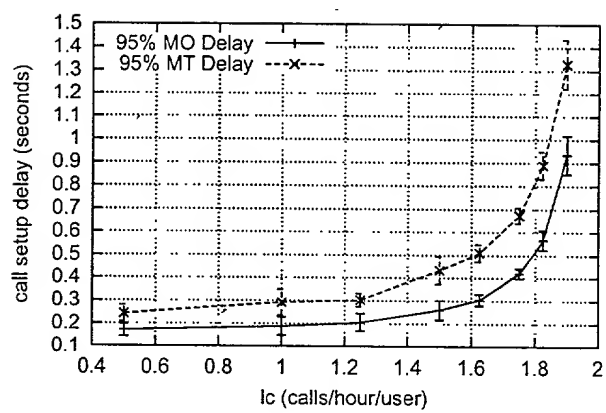


Fig. 32

332 a-d



102230-3T5E60

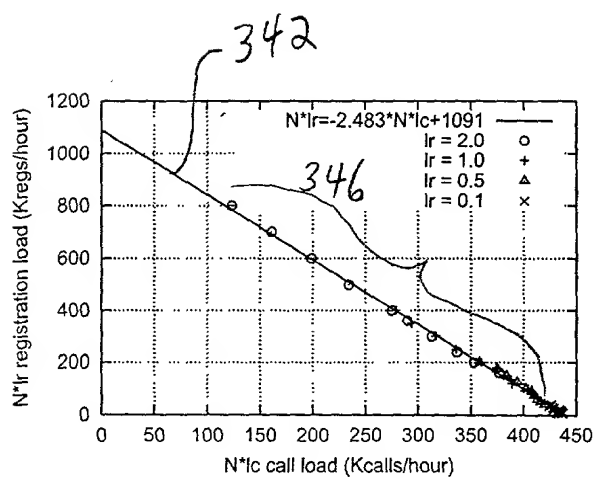


Fig. 34



352a-d

N (supportable population)

$N(lc,lr) \approx 1091/(lr+2.483*lc)$  .....  
actual measured data —

lc (calls/hr/user) range [0.25, 7.0]      lr (regs/hr/user) [0.0, 3.0]

Fig. 35

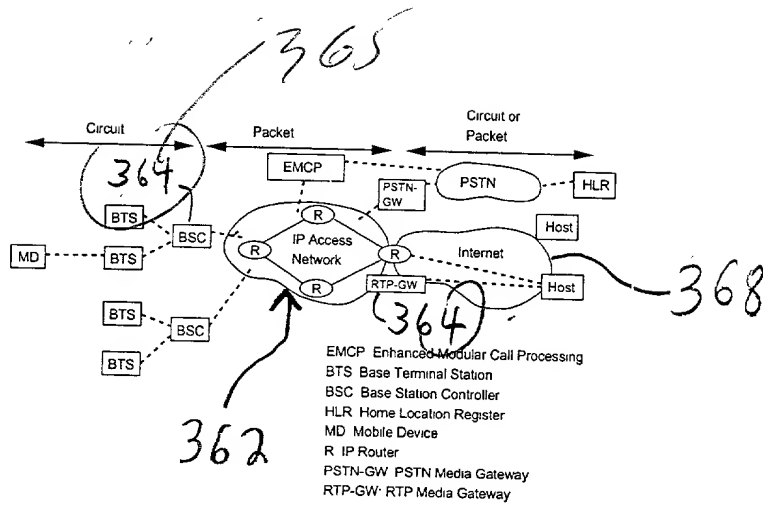


Fig. 36

FIG. 37

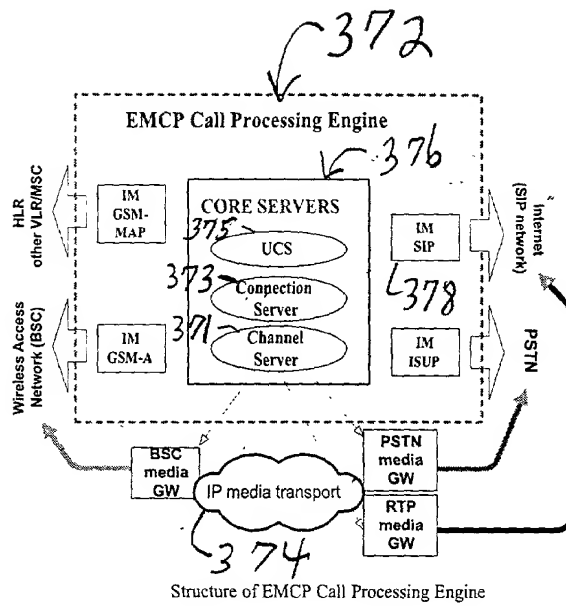


Fig. 37